Cloud Computing As a Tool for Enhancing Ecological Goals?

Analyzing Necessary Preconditions on the Consumer Side

Since its introduction, cloud computing has attracted considerable public interest and is seen as a major current topic in the information technology (IT) field. In addition to enabling data management efficiency, cloud computing is said to deliver energy savings, for instance through external data storage and data bundling on powerful mainframe computers. In spite of these promised benefits, the basic question remains whether the individual user possesses adequate knowledge about cloud services and values them sufficiently positively to accept and apply this new IT infrastructure. Will consumers appreciate what public authorities, media, and cloud providers alike are heavily promoting? If they do, rising demand for cloud services in combination with optimized hardware such as "thin clients" can indeed lead to positive environmental effects.

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The Authors

PD Dr. Ingrid Gottschalk (✉)
Institute for Health Care and Public Management
University of Hohenheim
Fruwirthstrasse 48
70593 Stuttgart
Germany
ingrid.gottschalk@uni-hohenheim.de

Prof. Dr. Stefan Kirn
Institute for Health Care and Public Management
University of Hohenheim
Schwerzstrasse 35
70593 Stuttgart
Germany
stefan.kirn@uni-hohenheim.de

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1 Introduction

Cloud computing has been introduced as a promising new model for the provision of information technology (IT) resources. A recent position paper by the European Commission proclaims that cloud services are a powerful instrument whose potential needs to be "unleashed" (European Commission 2012). Those high expectations can be attributed to system-related characteristics such as centralization, automation of service delivery, and quick adaptation to volatile service demand that may lead to better resource utilization and higher energy efficiency compared to current IT practices (Berl et al. 2010, p. 1045). The main characteristic of cloud computing as a delivery model is that a large pool of resources is managed by a provider who guarantees certain levels of service quality, as agreed with his customers, and offers these services on-demand with a rapid elasticity (Mell and Grance 2011). In sum, cloud computing can be defined as transferring personal computing activities to IT companies' centralized computers, thus giving the individual user and, if desired, co-workers or friends permanent access to (1) storage and processing capacity (infrastructure as a service, IaaS), (2) software platforms (platform as a service, PaaS), (3) software applications (software as a service, SaaS), and, through these services, also access to (4) personal data from any internet-equipped destination.

So far, cloud computing has primarily been discussed in the business-to-business (B2B) context (BITKOM 2013). In this context the so-called "private cloud" comes into play. In an on-premise private cloud, data is completely stored in-house, while in an off-premise private cloud, an external cloud provider hosts and administrates all data and applications in a separate area of his own data center. The model considered in the following is that of the public cloud where access is open to everyone. This constellation normally applies to situations of individual usage (business-to-consumers, B2C). Already at present, many consumers use cloud services for private purposes – although possibly without knowing that they are doing so – for example through the usage of certain e-mail providers or social networks. Apart from data management advantages, consumers can be motivated to use cloud services by means of financial and ecological benefits, for example if they learned that cloud usage could reduce their energy bill and help to protect the environment (Jaeger et al. 2009). The IT devices of private households in Germany consumed 60 % of the total energy consumption of IT in 2007, and the ratio is expected to further rise until 2020 (Stobbe et al. 2009). Thus, even small energy savings in each household may lead to a significant overall impact (Kumar and Lu 2010). However, these favorable prospects again rely on customer knowledge and acceptance of the new IT infrastructure.

Although cloud computing attracts a good deal of public interest, academic literature informs us insufficiently about the factors that affect cloud computing adoption by individual users. Instead, the focus of previous research has been almost exclusively on business applications (Marston et al. 2011). Although attempts have been made to measure factors that affect the adoption of cloud computing, these studies are primarily concerned with acceptance by firms or users within specific organizational settings, such as users in the public sector (Shin 2013), CIOs of large German companies (Opitz et al. 2011), managers of Taiwanese technology firms (Wu 2011), and students of community colleges (Behrend et al. 2011). These studies have enhanced our understanding of the adoption potential of cloud computing on an organizational level. However, with few exceptions (e.g., Park and Ryoo 2013), no emphasis has been placed on the adoption of cloud services for individual purposes. This research area thus constitutes an important research gap. Some indications of the factors that affect adoption by consumers can be taken from the study by Ratten (2012), who found support for a person's ethical orientation as well as the providers' marketing efforts. However, this study is restricted to a narrow set of factors and does not consider the ecological dimension of cloud services. The here presented literature gap is relevant for several reasons. Today, private households often need to dispose of various IT facilities, e.g., as prerequisite for part-time working options with quick access to data from any location. Cloud computing seems to constitute an ideal partner for that kind of work environment by encouraging home office spaces and by integrating employees who were otherwise excluded from the labor market, for instance because they were at home with young children. In this setting, the individual users and their special needs deserve further attention. Also in case of purely personal interests, consumers are increasingly in need of more capacity, such as storing and sharing private photos and films. Here, environmental concerns in terms of energy waste are reduced by economizing with help of the centralized cloud. It leads to enhanced possibilities for the utilization of waste heat, which is only beneficial in economies of scale and cannot be achieved by single private users. No study so far known to the authors of this paper has examined whether and to what extent the ecological aspects of cloud computing have an impact on user's perceptions of these services. We believe that this research gap can be reduced by integrating constructs and findings from technology acceptance research with those from consumer research.

Research in the field of green information systems (Green IS) may offer further valuable contributions to this paper's topic (Dao et al. 2011; Melville 2010; Watson et al. 2010). It is known from this literature that information systems researchers and makers alike are increasingly considering IT-practices in relation to environmental sustainability in general and energy abuse in particular (Berthon and Donnellan 2011; Bose and Luo 2011; Butler 2011; Zhang et al. 2011). How can IT contribute to achieving ecological goals while diminishing cost burdens at the same time? This question is at the core of Green IT as it "…refers to the using of IT resources in an energy-efficient and cost-effective manner" (Bose and Luo 2011, p. 1). Following this line, there is an ongoing discussion how eco-friendly solutions may stop soaring energy bills for business, for instance by substituting manifest with cloud capacity. The perspective in the study presented here, however, is a broader one. Marketers are no longer only seen as implementers, but also as promoters of the new Green information technology. Thus, private customers' needs and interests come into play. Consequently, the main focus of the present study is on the consumer-oriented approach which despite some significant efforts in that direction (e.g., DesAutels and Berthon 2011; Bengtsson and Agerfalk 2011) still constitutes an important research gap in Green IS.

In line with this, the research questions that guide this study are the following:

(1) Do consumers know about and show a favorable attitude in respect to cloud computing in general?
(2) Do consumers know about an energy saving potential of cloud services and how it could be realized?
(3) Which factors need to be addressed in order to stimulate cloud usage and thus promote efficiency and ecology gains?

The expected insights are relevant from both economic and ecological perspective as well as from the managerial side. Answers to these research questions could contribute to the design of proper incentives to attract different consumer groups to cloud services. Our research can be regarded as an initial step toward deepening understanding on how to make cloud computing an acceptable instrument of IT usage for consumers, communicate energy-efficiency effects of cloud services, and, as a positive side-effect, inform and sensitize consumers as to their personal energy-consuming behavior in relation to IT purposes (Watson et al. 2010, pp. 31–32).

Based on the theoretical foundation, our hypotheses and research framework will be lined out in Sect. 2 and followed by the methodology section of Sect. 3. Empirical results of a preliminary and the main consumer survey will be presented and discussed in Sect. 4. The paper concludes with a summary, considerations for further research and for the promotion of cloud services, and closes with a discussion of the limitations.

2 Background

2.1 Theoretical Foundation

This paper uses the theory of reasoned action (TRA) (Fishbein and Ajzen 1975) and the technology acceptance model

(TAM) (Davis 1989) as theoretical background. TAM, as the more recently developed model, explicitly draws on TRA as an antecedent, but primarily focuses on user acceptance of technical products and services. Both approaches can be usefully combined and integrated within a "hybrid intention model," as the authors of TAM themselves proposed (Davis et al. 1989, p. 994). This hybrid intention model seems to be well suited for addressing potential adopters' perceptions of cloud computing as an IT innovation (e.g., Moore and Benbasat 1991, p. 193; Chen et al. 2002). The main reason is the model's ability to reveal perceived advantages and risks in respect to the new IT infrastructure, thus indicating a starting point for consumer information policy.

The theory of reasoned action is concerned with personal beliefs with respect to intentional and volitional behavior, expressed in two independent variables, attitude toward behavior (AB) and subjective norm (SN). Variable AB deals with perceived advantages and disadvantages of performing the behavior under consideration (Ajzen and Fishbein 1980, p. 54). Variable SN comprises the subject's perceptions in respect to what extent others want him to behave in a certain way or not and his willingness to comply (Ajzen and Fishbein 1980, p. 57). Some criticism of this approach focuses on the alleged freedom of choice (e.g., Sheppard et al. 1988; Read et al. 2011). There may be situations in which a consumer is not free to base his decision merely on beliefs and preferences but rather has to comply with certain external or internal constraints. In fact, Ajzen himself has addressed this question by introducing an extension of TRA called the theory of planned behavior (TPB), which includes behavior restrictions in the form of a control factor, determined by control beliefs (Ajzen 1985, 1991; Ajzen and Madden 1986; Fishbein and Stasson 1990).

The technology acceptance model (TAM), which was especially developed to "explain and predict computer-usage behavior" (Klopping and McKinney 2004 p. 36), also works with individual beliefs, but restricts them to technical requirements (Davis 1989, 1993; Davis et al. 1989). This kind of "utilization focus" (Goodhue and Thompson 1995, p. 214), which aims at improving individual performance, is a common characteristic for task-technology oriented approaches (Goodhue and Thompson 1995; Teo 2012; Shih and Chen 2013). Two basic determinants, perceived ease of use (PEOU) and perceived utility (PU), are at the center of the TAM model and have been tested with various applications (Venkatesh 2000; Ma and Liu 2004). PU represents the expected total value of applying an information technology, especially with respect to improvements in work efficiency. PEOU comprises the effort it would take a person to use the IT product or service (Davis 1989, p. 320).

The authors of the technology acceptance model (TAM) successively proposed modifications of their model that ingrate additional factors (Venkatesh and Davis 2000; Venkatesh et al. 2003; Venkatesh and Bala 2008). At present, model development has reached TAM3 which includes more than a dozen further variables (Venkatesh and Bala 2008). Only some of these additional variables have been integrated into the authors' present joint approach of TRA and TAM for two reasons. First, cloud computing is a rather recent IT infrastructure that cannot be expected to be known to or used by all respondents of a survey sample. Thus, additional variables that require experience in using the technology are not included here. Second, due to TAM's focus on work performance, variables that concentrate on work issues such as job relevance (Venkatesh and Bala 2008, p. 314) are too narrow to cover the broader application of cloud services in both professional and private settings. Other variables were assumed to better fit the cloud computing topic and were thus included in the model, namely computer playfulness, computer anxiety, and image (Venkatesh and Bala 2008, pp. 313). All of these have been validated extensively by former research (e.g., Heinssen et al. 1987; Moore and Benbasat 1991; Webster and Martocchio 1992; Serenko and Turel 2007; Saadé and Kira 2007).

2.2 Hypotheses and Research Framework

Image, as discussed in the extended TAM3 model (Venkatesh and Bala 2008), creates interesting potential for examining whether social influences play a role in respect to perceived usefulness of computer applications. As IT activity often takes place in private settings, it seems plausible that social impact is rather weak. However, as cloud computing also involves activities of networking with the general public, there might be a demonstration effect regarding usage of the latest technology and thus gaining social status as an IT pioneer (Moore and Benbasat 1991, p. 195). Therefore we assume in respect to image:

H1: Image of using cloud services has a significant positive impact on perceived usefulness of cloud usage.

Likewise, the extended model TAM3 proposes that the subjective norm is related to perceived usefulness. This social variable embodies the notion that certain people might care about one's actions. In the framework of cloud services, family members may wish that everyone in the family is up-to-date with the latest IT technology, e.g., children with respect to their parents. It is also plausible to assume that reference persons from the professional field come into play, for instance employers or colleagues who would like to improve work efficiency and cooperation. Therefore it is expected that:

H2: Subjective norm has a significant positive impact on perceived usefulness.

TAM3 also emphasizes that perceived ease of use is related to attitude toward behavior and to perceived usefulness. That means that the convenience of handling a technical device influences work efficiency and constitutes an advantage for the user in terms of increases as to attitude and perceived usefulness. It is plausible to assume that the same consideration holds true for valuing cloud services. Therefore we assume that:

H3: Perceived ease of use has a significant positive impact on attitude toward cloud usage.

H4: Perceived ease of use has a significant positive impact on perceived usefulness of cloud usage.

Two additional factors that are part of the modified model are computer playfulness and computer anxiety. Both are expected to have a significant relationship to perceived ease of use but in different directions. Research has shown that handling a computer playfully may influence perceived complexity and manageability of the system (Hackbarth et al. 2003, p. 223). Applied to a cloud computing setting, this means that the potential user may playfully pass over possible application problems. Therefore we expect:

H5: Computer playfulness has a significant positive impact on perceived ease of cloud usage.

Alternatively, one can argue that individuals who lack ease of handling technical devices in general and tend to feel insecure when using computers will be hesitant with respect to all kinds of technical innovations. A person feeling insecure may even form a decisive barrier to action, as pointed out in the theory of planned behavior (Ajzen 1985). For that reason, we assume:

H6: Computer anxiety has a significant negative impact on perceived ease of cloud usage.

TRA aims at explaining, predicting and influencing various kinds of individual behavior (Ajzen and Fishbein 1980, p. 4). It is assumed that actors systematically use the information they possess and try to make reasonable decisions (Ajzen and Fishbein 1980, p. 5). In line with the structure of the theory of reasoned action, both constitutive determinants are hypothesized to have an impact on behavioral intention toward using cloud services. Therefore our expectation is that:

H7: Attitude toward behavior has a significant positive impact on behavioral intention toward cloud usage.

H8: Subjective norm has a significant positive impact on behavioral intention toward cloud usage.

The technology acceptance model predicts that perceived usefulness has a substantive influence on behavioral intention. This assumption is based on appreciating effort-saving techniques which are relevant for work efficiency (Davis 1989). In line with this reasoning it is expected that:

H9: Perceived usefulness has a significant positive impact on behavioral intention toward cloud usage.

Experience on working with a technological solution may increase preference for such a method and the intention to continue using it. These presumed effects may be explained in two ways. On the one hand, a person becomes more and more accustomed to a certain technique, increasing success and strengthening perceived benefit. On the other hand, while striving to avoid cognitive dissonance (Festinger 1957), a person sticks to former decisions, even if the results were not completely favorable. Transferring this line of reasoning to a cloud computing setting it is assumed that:

H10: Experience with cloud services has a significant positive impact on attitude toward cloud computing.

H11: Experience with cloud services has a significant positive impact on behavioral intention toward cloud computing.

To answer our research questions dealing with the energy savings of using cloud services, it is necessary to introduce a concept of environmental awareness. We draw on research on environmental concern and environmentally-friendly behavior (Kinnear et al. 1974; Ellen et al. 1991; Haws et al. 2012) in order to distinguish between higher and lower levels of environmental consciousness. It is assumed that consumers with divergent ecological values will react differently to products and services that promise positive environmental effects (cf. Kim and Chung 2011, p. 41). Again, the basic rationale is tied to considerations of consistency, embodied in theories of cognitive dissonance or self-perception (Festinger 1957; Bem 1967). Within the logic of these approaches, an individual who perceives himself as an ecologically-oriented person would suffer imbalance and inner tensions by acting in an environmentally-unfriendly manner. This would suggest that the individual would want to stay in line with his preferred environmental performance with respect to IT-purposes. Against this background it can be suggested that:

H12: Environmental awareness has a significant positive impact on behavioral intention toward cloud usage.

Research indicates that demographic variables such as gender and age may have an influence on attitude and behavior toward computer work (Whitely 1997; Enoch and Soker 2006; Ong and Lai 2006; Wang et al. 2009; Terzis and Economides 2011). This kind of research also implies causes and consequences of a so-called "digital divide" (DiMaggio et al. 2001, p. 310; Durndell and Thomson 1997; Enoch and Soker 2006). It may, for instance, be supposed that younger people or people who are better educated find it easier to adopt new technological advices than elderly or less educated consumers. Heinssen et al. (1987) found that gender plays a role in respect to the attitude toward computers in general. According to their research, women tend to be more timid in using computers than men (Heinssen et al. 1987, pp. 50–51). This could make them show more restraint to computer innovations than male users. Research could indeed show the relevance of demographic characteristics on computer program usage, which means that they were not fully mediated in TAM's proper belief constructs, as the model implies (Burton-Jones and Hubona 2005, p. 72).

Against this background it is assumed that:

H13: The demographic variable gender shows a significant negative impact on intending to use cloud services for female respondents.

H14: The demographic variable age shows a significant negative impact on intending to use cloud services for older respondents.

H15: The demographic variable education shows a significant positive impact on intending to use cloud services for higher educated respondents.

The following cloud computing research framework provides an overview of all hypotheses and visualizes the extended model approach. The four constructs in the middle of **Fig. 1** represent the main variables of TRA and TAM, respectively. They all represent underlying dimensions and are reflective variables, to be presented in ellipses. The same holds true for the majority of the further integrated variables. Experience, demographics, and behavioral intention constitute manifest variables that are symbolized by rectangles.

3 Method

3.1 Measures

The items for the TAM constructs were all taken directly from the original article (Venkatesh and Bala 2008, pp. 313–314), and had been validated by prior research (Venkatesh and Bala 2008, p. 283). The items were translated into German and adapted to this specific topic, but otherwise kept as closely to the original wording as possible. For measurement, 7-point Likert-type scales, ranging from strongly disagree to strongly agree, were used (Venkatesh and Bala 2008, p. 314). For all items, Cronbach's Alpha showed reliable results (see **Table 1**).

The items for both constructs of TRA, attitude toward behavior (AB) and subjective norm (SN), were derived according to the proposals of Ajzen and Fishbein, namely by eliciting beliefs through open questions and then presenting these beliefs for individual rating in a second study (Ajzen and Fishbein 1980,

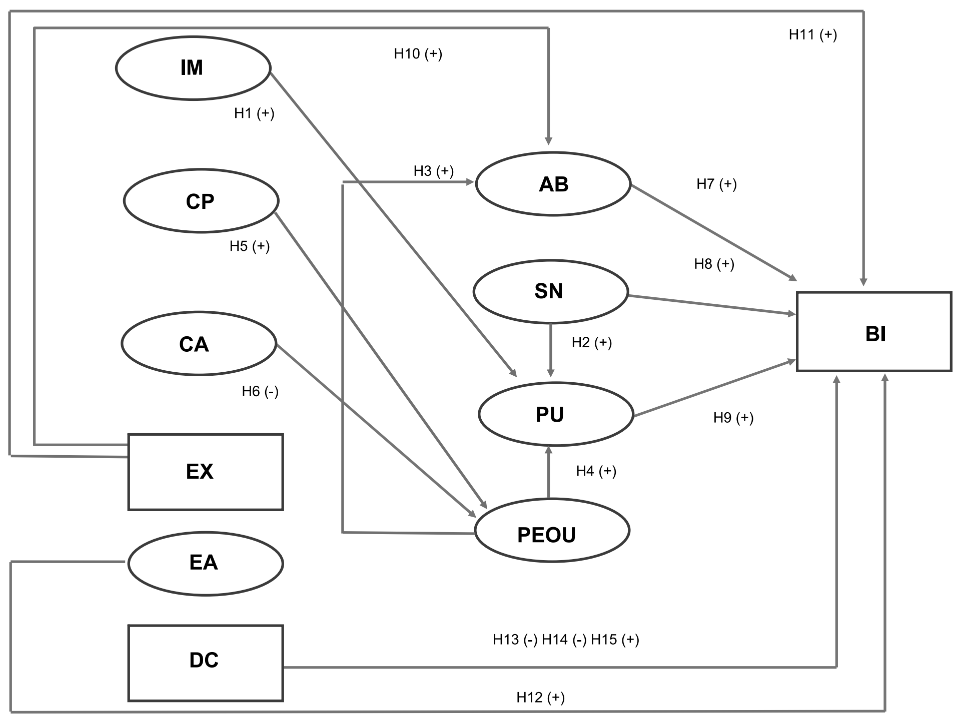

Fig. 1 Research framework. AB = Attitude toward behavior, BI = Behavioral intention, CA = Computer anxiety, CP = Computer Playfulness, DC = Demographic controls, EA = Environmental awareness, EX = Experience, IM = Image, PEOU = Perceived ease of use, PU = Perceived utility, SN = Subjective norm

Table 1 Items for TAM constructs (see Venkatesh and Bala 2008, pp. 313–324)

Constructs	Abbreviation	Cronbach's Alpha	Items
Image	IM	0.874	1. People who use cloud services have more prestige than those who do not
			2. Cloud users have a high social profile
			3. Using the cloud is a status symbol
Computer playfulness	CP	0.730	*Working with the computer I am rather...*
			1. spontaneous
			2. creative
			3. playful
			4. original
Computer anxiety	CA	0.926	*Computer and computer programs...*
			1. scare me
			2. make me nervous
			3. make me feel uncomfortable
			4. make me feel uneasy
Perceived ease of use	PEOU	0.908	1. The use of cloud services is clear and understandable
			2. My use of cloud services does not require a lot of my mental effort
			3. Cloud services are easy to use
			4. I find it easy to get cloud services to do what I want them to do
Perceived usefulness	PU	0.927	*The use of cloud services...*
			1. improves my performance
			2. increases my productivity
			3. enhances my effectiveness
			4. is useful for carrying out my tasks

Table 2 Behavioral beliefs

Advantages: Cloud services...
1. ensure access to personal data from different locations.
2. save money by supplying demand-driven services (e.g., software, music and movies).
3. prevent data loss (e.g., in case of individual hardware break down).
4. enhance the environment by reducing overall energy consumption.
5. reduce software installation effort.
6. update software automatically.
7. lower individual energy cost.
8. simplify team work through shared data storage.
Disadvantages: Cloud services...
1. make customers more transparent.
2. make me dependent on a functioning internet connection.
3. cause data loss in case of a server failure of the provider.
4. simplify hacker attacks and cyber espionage.
5. do not tell me where my data is stored.
6. create dependence on the provider under contract.
7. do not offer clear responsibilities in case of a damage.
8. are a financial trap due to monthly charges.

Table 3 Normative beliefs

Reference persons expecting the individual to make personal use of cloud services
1. Colleagues/fellow students
2. Employer/teachers
3. Family/friends (private environment)

pp. 62–66). In order to elicit relevant behavioral and normative beliefs, 20 individuals participated in the preliminary study. All respondents were personally addressed and asked for participation in a paper and pencil questionnaire. All of them were offered further instruction if needed. The majority of the sample could be recruited from university staff and students. Thus, acquaintance with IT infrastructures could be expected.

A content analysis was carried out to extract the respondents' beliefs on cloud computing. The problem of separating between salient and non-salient beliefs is frequently solved by applying rules such as considering beliefs spontaneously mentioned by 10 to 20 per cent of the sample (Ajzen and Fishbein 1980, p. 70) or by at least 50 per cent of the respondents (Ryan and Etzel 1976, p. 489). Bearing in mind that cloud computing is a rather new topic with so far only limited possibilities of personal experience, we did not expect to obtain a large number of associations. Thus, we only omitted the few comments that did not really fit the topic. It is interesting to note that none of the respondents actually mentioned cloud computing's energy saving aspects. It seems that people have to be asked for it directly. To offset this deficit, two additional beliefs on energy saving gains were integrated. Finally, a list of 16 behavioral beliefs, comprising eight perceived advantages and eight perceived disadvantages, was established (see **Table 2**). To operationalize attitude toward behavior (AB), each behavioral belief had to be rated on 7-point Likert scales according to perceived probability (b_i) and evaluation (e_i) and the products of both were summed up, following the instructions by the authors of the model ($AB = \sum b_i e_i$) (Ajzen and Fishbein 1980, p. 56).

Normative beliefs were mentioned considerably less frequently than behavioral beliefs and only three beliefs were extracted. They were also identified through content analysis and describe the normative impact of a teamwork, an institutional, or a private context (see **Table 3**). As with AB, the subjective norm (SN) was operationalized by the sum of rated probability (b_j) times attested motivation to comply (m_j) per normative belief ($SN = \sum b_j m_j$) (Ajzen and Fishbein 1980, p. 56).

As basis for measuring environmental awareness, we used the research of Haws et al. (2012) to establish an ecological consciousness scale. It deals with the GREEN Consumer Values Scale (Bearden et al. 2011, pp. 172–173). The GREEN scale consists of six items, each assessed on 7-point Likert-type scales that are averaged to result in a single figure. Higher scores indicate a more positive inclination toward environmentally-friendly behavior (see **Table 4**).

Experience with cloud computing was operationalized as a dummy variable, asking for: Are you already using cloud services? (yes/no). To make sure that the answer was correct and that people did not overlook their cloud activity, examples like dropbox or Googlemail were given (see the questionnaire excerpt in Online-Appendix A). Behavioral intention for cloud use was also measured as a manifest construct. The question ("To what extent are you willing to use cloud computing services?" $1 =$ not at all, $7 =$ very much) was carefully formulated to offer each group, users and non-users, the opportunity for a reasonable answer.

As cloud computing has been introduced and started to be discussed in the media only recently, general knowl-

Table 4 Environmental consciousness scale (taken from Haws et al. 2012, p. 41)

How would you fit into the following statements?
1. It is important to me that products I use do not harm the environment.
2. I consider the potential environmental impact of my actions when making many of my decisions.
3. My purchasing habits are affected by my concern for our environment.
4. I am concerned about wasting the resources of our planet.
5. I would describe myself as environmentally responsible.
6. I am willing to be inconvenienced in order to take actions that are more environmentally friendly.

Table 5 Profile of sample candidates ($n = 234$)

Variable	Characteristics	Percent ($n = 234$)
Gender	male/female	43.2/56.8
Age	<35 years/≥35 years	59.4/40.6
Education	lower level/higher level	14.1/85.9
Knowledge about cloud computing	yes/no	85.9/14.1
Use of cloud services	yes/no	47.9/52.1
Use in case of knowledge ($n = 201$)	yes/no	55.7/44.3

edge on this topic is probably incomplete or even lacking. Thus a short but appropriate definition of the topic needed to be integrated into the beginning of the questionnaire. Perceived advantages and disadvantages, as well as the items of the constructs, were presented in a randomized order to avoid ordering effects.

3.2 Procedures

In total, $n = 13$ respondents of presumed different knowledge of the topic were addressed personally to pretest the questionnaire by paper and pencil. Additionally, $n = 12$ persons were asked to follow the link and answer the questions online, just as the main sample was supposed to do, with the exception that further comments could be added in case of comprehension problems. Accordingly, some items were reformulated, for example, through rewording complicated technological terms. After gaining confidence that no further technical or content-related problems were existent, the online questionnaire could be activated. It included 18 closed questions, mainly to be answered on 7-point Likert scales (see a sample side of the questionnaire in Online-Appendix 1).

The main consumer survey was conducted by inviting the participation of a German online panel during two weeks in October, 2012. This panel is comprised of a non-commercial pool of people who have previously agreed to participate in surveys for scientific purposes. The panel is administered by a university institution that requires adherence to strict quality guidelines in the questionnaire. The members of the SoSci Panel are mainly academics, including university staff and students. The cover mail of the survey tried to arouse interest through promising a new topic while assuring anonymity.

Samples that are drawn from such a panel population are convenient samples. In case of the topic at hand this is not necessarily a disadvantage, as the technology is still in an early stage where a population-wide adoption cannot be assumed. It is rather the educated segment that is expected to belong to the users of cloud technology, thus making a panel consisting of members with a higher education an ideal partner. Nevertheless, a certain spread of demographic criteria was intended by inviting different groups of gender and age. The clicks per group varied between 20 and 25 per cent, which is a normal rate according to the panel operator (SoSci Panel 2012). About one third clicked into the questionnaire without completing it, leaving the page either directly or after some minutes. Given the technical nature of a rather new topic this is understandable. Consistent with panel practice, panelists are given the freedom to skip questions. As structural equation modeling (SEM) was envisaged to test the hypotheses, however, a complete dataset without missing values is required, leaving us finally with a sample of $n = 234$ participants.

4 Empirical Results

4.1 Sample and Descriptions

The final sample contained relatively more female and younger respondents. In accordance with the member structure of the panel, respondents who finished high school or graduated from university represented the large majority. It could be expected that the rather young and well-educated online sample was already informed about cloud computing as an IT infrastructure. This was indeed the case for the vast majority of the sample. Less than half of all respondents were already using cloud services at the time of the survey. This percentage increases to 55.7 percent when referring to those who were familiar with the concept (see **Table 5**).

From our list of 16 behavioral beliefs, data cleaning demanded the partial exclusion of one belief which had obviously been misunderstood. This was the possibility that cloud services could "... simplify hacker attacks and cyber espionage" (see **Table 2**). In spite of the pretests, the positive wording (though directed toward a negative consequence) must have caused the sample to rate this belief as rather advantageous on average and thus had to be excluded from forming the attitude toward behavior component.

According to TRA, AB and SN consist of the sum of perceived probabilities multiplied by evaluations per belief (Ajzen and Fishbein 1980, p. 56). Given the rating scales used, beliefs can be rated

Table 6 Findings for behavioral beliefs

Cloud services...	Ratings of probability times evaluation	
	M	S.D.
1. prevent data loss (e.g., in case of individual hardware break down)	11.09	7.09
2. ensure access to personal data from different locations	9.78	7.54
3. update software automatically	7.64	6.63
4. simplify teamwork through shared data storage	6.29	7.60
5. reduce software installation effort	5.50	6.10
6. save money by supplying demand-driven services	5.44	5.72
7. enhance the environment by reducing overall energy consumption	4.50	4.80
8. lower individual energy cost	3.61	4.65
9. are a financial trap due to monthly charges	−6.36	6.31
10. cause data loss in case of a server failure of the provider	−6.83	6.36
11. do not tell me where my data is stored	−6.95	7.94
12. create dependence on the provider under contract	−7.39	7.80
13. make me dependent on a functioning internet connection	−7.41	8.45
14. do not offer clear responsibilities in case of a damage	−9.49	7.69
15. make customers more transparent	−10.07	7.66
Attitude toward behavior (AB)	−0.65	

Table 7 Findings for normative beliefs

Reference people expecting the individual to make personal use of cloud services	Ratings of probability times motivation to comply	
	M	S.D.
1. Colleagues/fellow students	2.60	7.71
2. Employer/teachers	1.80	8.66
3. Family/friends (private environment)	−0.69	8.04
Subjective norm (SN)	3.71	

within a range of −18 to +18. Here, the most favored advantage of cloud services was the prevention of data loss (M = 11.09). The most negatively rated disadvantage was that cloud services could make customers more transparent (M = −10.07). Attitude toward cloud usage turned out to be very slightly negative on average (M = −.65) (see **Table 6**).

Beliefs in respect to environmental and energy saving goals do not seem to play a role at all. In fact, both beliefs which refer to ecological aspects, either for the sake of the environment as a whole or to reduce one's private energy bill as a positive side effect of saving energy, are at the bottom of the list of advantages. A further analysis of these two beliefs demonstrates that all groups of respondents attest low probabilities to the ecological effects of cloud computing, independently of knowing about or using this new IT infrastructure. People seem to simply not, or at least not yet, believe in those effects.

The elicited normative beliefs represent three different groups of potential normative impact. Although all normative beliefs were overall of rather minor importance, the data show that colleagues and fellow students of the teamwork category were relatively most important in respect to someone's use of cloud services (M = 2.60). The subjective norm for the sample as a whole is slightly positive (SN = 3.71) (see **Table 7**).

4.2 Results of Hypotheses Testing

4.2.1 Factor Analysis

To test our hypotheses, factor analysis and structural equation modeling (SEM) were carried out. Attitude toward behavior (AB) consists of 15 underlying beliefs that comprise perceived positive and negative expectations in regard to using cloud services (see **Table 6**). As these beliefs contain a variety of different advantages and disadvantages with respect to cloud computing, multi-dimensionality can be assumed and thus had to be tested by exploratory factor analysis. We extracted the factors via principal component analysis and performed a varimax rotation on factors with an eigenvalue higher 1, which enabled us to identify four factors.

Factor A contains all disadvantages that were associated with using cloud services. This factor can therefore be called "cloud risks". A further distinction between perceived negative consequences of cloud computing could not be identified. This is different on the benefits side. Factor B encompasses positive financial and network aspects and can therefore be named "cloud efficiency". As expected, factor C solely encompasses questions on the environmental effects of cloud computing and can hence be called "cloud green". Finally, factor D mainly stands for the additional comfort that cloud services may embody and hence describes advantages of "cloud convenience" (see **Table 8**).

Table 8 Results of factor analysis

Beliefs: Cloud services ...	Components A	B	C	D
A Cloud risks factor				
1. ... do not offer clear responsibilities in case of a damage	.758			
2. ... do not tell me where my data is stored	.736			
3. ... make customers more transparent	.730			
4. ... make me dependent on a functioning internet connection	.699			
5. ... create dependence on the provider under contract	.689			
6. ... are a financial trap due to monthly charges	.642			
7. ... cause data loss in case of a server failure of the provider	.517			
B Cloud efficiency factor				
8. ... ensure access to personal data from different locations		.735		
9. ... prevent data loss (e.g., in case of individual hardware break down)		.728		
10. ... simplify team work through shared data storage		.641		
11. ... save money by supplying demand-driven services (e.g., software, music and movies)		.525		
C Cloud green factor				
12. ... enhance the environment by reducing overall energy consumption			.815	
13. ... lower individual energy cost			.712	
D Cloud convenience factor				
14. ... reduce software installation effort				.740
15. ... update software automatically				.625

Table shows only factor loadings above 0.5

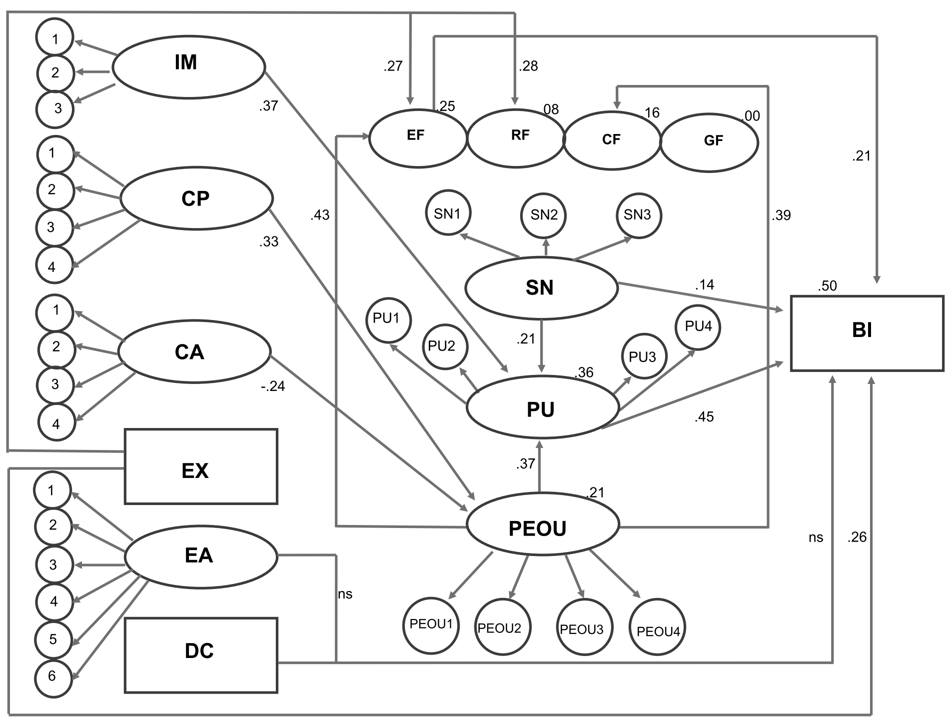

Fig. 2 Standardized regression weights and squared multiple correlations. BI = Behavioral intention, CA = Computer anxiety, CF = Convenience factor, CP = Computer playfulness, DC = Demographic controls, EF = Efficiency factor, EA = Environmental awareness, EX = Experience, GF = Green factor, IM = Image, PEOU = Perceived ease of use, PU = Perceived utility, RF = Risks factor, SN = Subjective norm

To examine reliability of the identified factors, individual factor reliability values were calculated, showing a satisfactory level of over 0.6 in three cases (risks factor = 0.81, efficiency factor = 0.70, green factor = 0.66), and a level of over 0.5 in one case (convenience factor = 0.59), which remains a sufficient value (Bagozzi and Yi 1988, p. 80; Weiber and Mühlhaus 2010, p. 127). A test for discriminant validity according to the Fornell-Larcker-criterion (Weiber and Mühlhaus 2010, p. 135) showed that the average variance extracted (AVE) values exceeded the squared correlations for all factors, except for the convenience factor in relation to the efficiency factor. Here, AVE for the convenience factor is smaller (0.38) than the squared correlation between both factors (0.44). Consequently, we experimented with reducing the model to three factors only, but as a consequence the model fit did not improve. Thus, the four-factor solution was carried out for the present SEM.

4.2.2 Structural Equation Modeling (SEM)

In order to test hypotheses 1 to 15, we applied a structural equation modeling approach (SEM). This statistical procedure is appropriate for testing complex relationships between variables, as is the case in the research framework at hand (see **Fig. 1**) (Homburg and Baumgartner 1998, p. 142; Hildebrandt and Görz 1999, p. 2; Weiber and Mühlhaus 2010, p. 18; Schumacker and Lomax 2010, p. 2). To estimate the overall model we followed the argument of Weiber and Mühlhaus (2010, pp. 176–178), who suggest testing criteria from three domains in order to qualify a "good" model in which the first two domains assess the model fit and the third domain measures the parsimony of the model (Weiber and Mühlhaus 2010, p. 176).

First, we used the Root Mean Square Error of Approximation (RMSEA) test for the inferential model fit. According to Browne and Cudeck (1992), a value of RMSEA below 0.05 would indicate a close fit, while RMSEA ranging between 0.05 and 0.08 would be reasonable (Browne and Cudeck 1992, p. 239). As the obtained result amounts to 0.05, it only slightly misses the "close fit" threshold and can easily be classified as reasonable. Second, chi-square is an overall descriptive model fit measure that should not exceed 2.5 (Homburg and Baumgartner 1998, p. 363). Our model fulfills this criterion, as it amounts to 1.6. Third, parsimony is given if the value of the Comparative Fit Index (CFI) exceeds 0.90 (Zinnbauer and Eberl 2004, p. 19). The model used in this paper shows that CFI equals 0.88, which means that it misses, even though slightly, the critical threshold. However, it is to be kept in mind that these cutoff-criteria are classified according to "rules of thumb" (Hu and Bentler 1999, p. 4). Likewise, the assessment of model fit has been described as even more problematic when the sample size is small, which is the case in the present study (Fan et al. 1999, p. 57). All in all, it can be assumed that the applied mixed model approach of TAM, TRA and further cloud-relevant variables as used in the present study, is adequate for the field of cloud computing.

The results of SEM are illustrated in **Fig. 2**, showing standardized regression weights (β) and squared multiple correlations (R^2). Integrating the four separate factors of AB, finally a list of 24 hypotheses was to be tested. **Table 9** specifies support or rejection, respectively. Both results deserve further attention.

As far as TAM is concerned, many variables show the expected impacts the model predicts. Cloud computing intentions of the sample are generally influenced by an interplay of perceived ease of use and perceived usefulness with further latent variables such as image, computer anxiety and computer playfulness. As expected, being playful while using computers is helpful in developing a positive expectation towards the handling of the new infrastructure, while feeling somewhat unsure about or even afraid of computer work leads to the envisaged negative expectations (H5 and H6). In both cases, the standardized regression weights (β) demonstrate significance and show the expected signs (+0.33 for CP and −0.24 for CA). The squared multiple correlations coefficient (R^2) for PEOU explains 21 per cent of the variance (see **Table B-1** in the Online-Appendix). In H3, perceived ease of use was expected to significantly impact attitude toward behavior. Following the disaggregation of AB to four underlying factors this relation is highly significant in respect to the efficiency factor ($\beta = 0.43$, $p < 0.001$) and gains medium support for the convenience factor ($\beta = 0.39$, $p < 0.01$), but it is not significant concerning the remaining two factors. This is valuable information for promotion purposes, as it points to information deficits, e.g., with respect to stressing all possible advantages of cloud computing.

Perceived usefulness is expected to be influenced by two socially oriented variables, namely image and subjective norm. In both cases, the underlying hypotheses (H1 and H2) can be supported, with a high impact for image ($\beta = 0.37$, $p < 0.001$) and a medium support for the subjective norm ($\beta = 0.21$, $p < 0.01$) (see **Fig. 2** and **Table 9**). These results demonstrate that cloud computing may have a substantial social component and that the current buzz in the media about cloud computing comes just at the right moment to stimulate the IT innovation. In H 9, PU is the independent variable that is expected to impact behavioral intention. This expectation can be strongly supported ($\beta = 0.45$, $p < 0.001$). Thus, the main TAM variable shows strong relevance for cloud purposes and may be more carefully observed as a good sales argument.

The impacts of the main variables of the TRA model, which are attitude toward behavior, represented by the four factors, and subjective norm, are noticeable but not very strong. Both main variables do have a significant impact on behavioral intention, but in both cases there is only a weak support. This holds true for the efficiency factor, the only one AB factor that is supported (H7a, $\beta = 0.21$, $p < 0.05$) as well as for SN (H8, $\beta = 0.14$, $p < 0.05$). Nevertheless, the analytic value of the TRA components can be derived from specifying the underlying beliefs structure. Here, many important details become visible and come into play, like the leading beliefs on the advantages and the disadvantages side. They deserve the special treatment of marketers in the field of cloud computing. All things considered it can be argued that both negative and positive associations with cloud services need to be addressed in order to promote cloud usage. Interestingly though, it seems to be more effective to highlight the benefits of cloud computing rather than to try to dispel doubts regarding this new technology. In respect to the manifest variable experience, it can be shown that actual use significantly impacts both attitude factors, namely efficiency and risks (H10a, $\beta = 0.27$, $p < 0.01$, H10b, $\beta = 0.28$, $p < 0.01$), and intentions to use the new IT infrastructure (H11, $\beta = 0.26$, $p < 0.001$). Thus, it is supported that past activity confirms attitude and intention to continue.

All in all, behavioral intention shows a value for R^2 of 0.50 (see **Table B-1** in the Online-Appendix), meaning that 50 per cent of its variance is explicable in the present model through the efficiency factor, subjective norm, perceived utility, and experience. Contrary to our expectations, a significant impact of environmental awareness on cloud computing intentions could not be found (H12).

Table 9 Evaluation of hypotheses

Hypotheses	β	p	Support
H1: Image of using cloud services has a significant impact on perceived usefulness of cloud usage.	0.374	$p < 0.001$	Strong
H2: Subjective norm has a significant impact on perceived usefulness.	0.208	$p < 0.01$	Medium
H3: Perceived ease of use has a significant impact on attitude toward cloud usage.			
Modification: PEOU significantly impacts:			
Efficiency factor toward cloud usage (H3a).	0.425	$p < 0.001$	Strong
Risks factor toward cloud usage (H3b)	−0.016	ns	Rejection
Convenience factor toward cloud usage (H3c)	0.394	$p < 0.01$	Medium
Green factor toward cloud usage (H3d)	0.051	ns	Rejection
H4: Perceived ease of use has a significant impact on perceived usefulness of cloud usage.	0.373	$p < 0.001$	Strong
H5: Computer playfulness has a significant positive impact on perceived ease of cloud usage.	0.325	$p < 0.001$	Strong
H6: Computer anxiety has a significant negative impact on perceived ease of cloud usage.	−0.238	$p < 0.001$	Strong
H7: Attitude toward behavior has a significant impact on behavioral intention toward cloud usage.			
Modification: Four factors significantly impact BI:			
Efficiency factor impacts BI (H7a).	0.211	$p < 0.05$	Weak
Risks factor impacts BI (H7b).	0.090	ns	Rejection
Convenience factor impacts BI (H7c).	0.117	ns	Rejection
Green factor impacts BI (H7d).	0.027	ns	Rejection
H8: Subjective norm has a significant impact on behavioral intention toward cloud usage.	0.143	$p < 0.05$	Weak
H9: Perceived usefulness has a significant impact on intending to use cloud services.	0.446	$p < 0.001$	Strong
H10: Experience with cloud services has a significant impact on attitude toward cloud computing.			
Modification: Experience significantly impacts:			
Efficiency factor (H10a).	0.268	$p < 0.01$	Medium
Risks factor (H10b)	0.277	$p < 0.01$	Medium
Convenience factor (H10c)	−0.012.	ns	Rejection
Green factor (H10d)	0.033	ns	Rejection
H11: Experience with cloud services has a significant impact on behavioral intention toward cloud computing.	0.262	$p < 0.001$	Strong
H12: Environmental awareness has a significant impact on behavioral intention toward cloud usage.	0.030	ns	Rejection
H13–15: Demographic variables show a significant impact on intending to use cloud services.			
H13: Gender shows a significant negative impact on BI for female respondents.	−0.031	ns	Rejection
H14: Age shows a significant negative impact on BI for older respondents.	−0.037	ns	Rejection
H15: Edu shows a significant positive impact on BI for higher educated respondents.	−0.04	ns	Rejection

Participants of the sample who dispose of higher environmental consciousness are no more inclined toward cloud computing than respondents with lower environmental values. Therefore, H12 cannot be supported. It seems that environmental considerations only play a minor role, if they play a role at all, when it comes to considering the use of cloud services. The green cloud factor represents environment effects for the economy and society as a whole on the one hand and individual financial benefits by reducing the private energy bill on the other hand. From the analysis of the data of this present study it must be concluded that the green factor is neither significantly impacted by other independent variables such as experience, nor does it show a significant impact on dependent variables like behavioral intention.

Finally, for demographic characteristics a significant relationship is lacking, which means that gender, age, and education do not play a direct role regarding the intention to use cloud services (H13, H14, and H15). However, demographics may play an indirect role, as is the case for computer playfulness. This scale measures whether people enjoy computer work, encompassing items like spontaneity or creativity in computer use (Venkatesh and Bala 2008, p. 313). The majority of this sample experience this kind of pleasure, but older respondents classified themselves as significantly less playful in respect to computer activities ($p \leq 0.05$). In contrast to earlier results on computer anxiety (e.g., Ong and Lai 2006; Venkatesh and Bala 2008, p. 313), no indirect effect could be found in respect to gender. In their research on computer anxiety, Heinssen et al. (1987) had found that women tended to be more afraid of computers than men (Heinssen et al. 1987, pp. 50–51). In our sample this is not the case (see **Fig. 2** and **Table 9**).

5 Prospects and Conclusions

5.1 Supporting Cloud Usage by Technical Analysis

"Information systems cannot be effective unless they are used," (Mathieson 1991, p. 173). This statement holds true for cloud services as well, as they can only show their capacity if accepted and

Table 10 Positive beliefs and technical facts

Perceived advantages of cloud services...		Evaluation	Acknowledging support by IT analysis...	Support
1.	... prevent data loss	++	... by cloud storage and mechanisms for disaster recovery	yes
2.	... ensure access to own data from different locations	++	... by standardized communication protocols	yes
3.	... update software automatically	++	... by automated software updates on the provider's side	yes
4.	... simplify team work through shared data storage	+	... by shared data storage and software service for collaborative work	yes
5.	... reduce software installation effort	+	... by standardized, out-of-the-box services (pre-configured)	yes
6.	... save money by supplying demand-driven services	+	... depends on the applied pricing scheme	partly
7.	... enhance the environment by reducing overall energy consumption	(+)	... several studies identify positive effects on energy efficiency	no
8.	... lower individual energy cost	(+)	... depends on the individual use of local hardware	partly

Table 11 Negative beliefs and technical facts

Perceived disadvantages of cloud services...		Evaluation	Acknowledging support by IT analysis...	Support
1.	... make customers more transparent	– –	... not in case of encrypted data storage or guaranteed privacy level	partly
2.	... do not offer clear responsibilities in case of a damage	– –	...Service Level Agreements (SLAs) can regulate responsibilities	partly
3.	... make me dependent on a functioning internet connection	– –	... a pervasive and reliable Internet connection is required	yes
4.	... create dependence on the provider under contract	– –	... may arise when using proprietary software services from providers	partly
5.	... do not tell me where my data is stored	–	... cloud providers may restrict allocation to preferred site	partly
6.	... cause data loss in case of a server failure of the provider	–	... cloud servers are backed up by default, additional data security requires separate contract	partly
7.	... are a financial trap due to monthly charges	–	... depends on the contract	partly
8.	... simplify hacker attacks and cyber espionage	missing	... preventable through guaranteed privacy level	partly

widely used. In line with the significant impact of perceived usefulness and efficiency considerations on cloud computing behavioral intention, the fundamental strategy should consist of providing customized information backed by technical facts. The potential or actual user of cloud services may respond positively if technical competence can support the desired benefits and remove adverse barriers.

Tables 10 and **11** present advantages and disadvantages of using cloud services as perceived by the present sample. Sorted into positive and negative beliefs they are listed according to their relative weights (see **Table 6**) and technical facts. In respect to a possible range between −18 and +18, beliefs were categorized as fairly important "++" if M exceeded or was equal to 7, as still important "+" if M was equal to or greater than 5 but smaller than 7, and as of little importance "(+)" if M was below 5. The same qualification was applied for the disadvantages, in this case for M absolute, using minus instead of plus. Whether consumer expectations were confirmed by technical analysis was expressed through three different statements: "yes" in case of complete support, "partly" if expected advantages or disadvantages were only realized under certain conditions, and "no" if the users were wrong in what they were expecting.

In respect to perceived advantages of cloud computing, many highly ranked expectations on side of the consumers are technically underlined. It is, for instance, confirmed that storage in the cloud effectively prevents data loss and ensures access to data from any location (see **Table 10**). Regarding the adverse aspects, information technology claims that several problems like the unknown location of data storage and the risk of data loss have already been resolved (see **Table 11**). Generally, the coincidence between consumer expectations and IT facts is higher for advantages than for disadvantages. As IT analysis confirms, positive aspects such as teamwork simplification and reduction of installation effort of software could be stressed even more. The alleged price advantage of pay–as-you-use constellations, however, has to be put in due perspective, as it depends on the actual pricing scheme and can only partially be supported. However, consumer evaluation of the ecological beliefs contrasts IT analysis. Research provides evidence that cloud computing can increase the energy efficiency of IT through dynamically reconfiguring resources to adjust a variable load, allowing for a higher resource utilization (Berl et al. 2010, p. 1045; Shuja et al. 2012, p. 973). To realize energy savings for the individual, cloud computing has to be applied with less energy-consuming hardware as a prerequisite (e.g., "thin clients"). Here, respondents have reason to doubt an automatic personal energy-saving effect by simply turning to cloud service providers. The prevailing lack of complete concordance between perceived disadvantages and technical support, however, is positive when it comes to convincing people to use the new cloud infrastructure. The huge majority of disadvantages are quoted as "partly" right, which means that consumers' concerns could largely be dispelled.

5.2 Summary and Consequences

The present study was based on a research framework drawn from the theory of reasoned action (TRA) and the technology acceptance model (TAM). With this paper, we portray the adequacy of this combined model approach for analyzing cloud computing from a consumer perspective. Thus, the presented theoretical basis can form a solid background for continuing research on this topic. The latter is particularly necessary as the results show that a large proportion of respondents in our sample still doubt the net value of cloud computing in general, and that they largely neglect the possibility of ecological gains in particular. This result mirrors the current deficit of consumer orientation in the field of Green IS, both in theory and practice. The topic of this paper may therefore be taken as a first step in this direction and a contribution to this research gap.

By using an online sample and structural equation modeling, several significant impacts could be shown. The main variables of TRA and TAM show the expected impacts. In particular, we see reason to conclude that social dependencies are of great relevance. Both forms of social influence seem to play a role, image as a more general perception of social pressure to become involved in the latest information technology infrastructure, as well as subjective norm and reference persons whose expectations should not be disappointed in the eyes of the users. Unexpected, however, was the finding that a majority of respondents do not yet believe that cloud computing is related to energy savings. The consequential question for practitioners is how to convince these persons of the opposite. Increasing perceived probability of the ecological effects can be one fundamental factor. The usual assumption that ecological behavior is a burden in terms of time, effort, and resources (Pensini et al. 2012, p. 537) does not apply to cloud services. Thus, eco-oriented people could easily contribute to their goal without giving up competing goals such as economy and comfort. To convince less eco-minded consumers, an effective strategy might be to point out the interdependence between public and private benefits of cloud computing. For example, newly acquired IT hardware in combination with a cloud infrastructure needs much less storage space, making the product less costly to buy and more energy-saving to use. Thus, the key to stimulating demand for cloud services lies in trustworthy communication backed by technical facts. If experts confirm that energy efficiency gains are a realistic result of cloud usage, doubts will diminish, generating a further advantage of cloud computing. A trustworthy educational campaign could succeed in turning around expectations and convincing broad sections of the population to participate in cloud computing activities.

There are several limits to the present analysis that need to be dealt with in further research. The sample was drawn from an online panel representing members of a special segment. This study should be replicated with a large representative sample. To gain further insights, in-depth interviews with users and critics of cloud computing would also be beneficial. Research in the IT field should fill existing knowledge gaps with solid data and transmit the results in a comprehensible manner, also to those consumers who neither dispose of special IT skills nor are particularly interested in such topics. This is a prerequisite if cloud computing activities are really to be boosted.

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Abstract

Ingrid Gottschalk, Stefan Kirn

Cloud Computing As a Tool for Enhancing Ecological Goals?

Analyzing Necessary Preconditions on the Consumer Side

Cloud computing has been introduced as a promising information technology (IT) that embodies not only economic advantages in terms of increased efficiency but also ecological gains through saving energy. The latter has become particularly important in view of the rising energy costs of IT. The present study analyzes whether necessary preconditions for accepting cloud computing as a new infrastructure, such as awareness and perceived net value, exist on the part of the users. The analysis is based on a combined research framework of the theory of reasoned action (TRA) and the technology acceptance model (TAM) in a cloud computing setting. Two consumer surveys, the one to elicit beliefs and the second to gain insight into the ranking of the variables, are employed. This study uses structural equation modeling (SEM) to evaluate the hypotheses. The results indicate support for the proposed research framework. Surprisingly however, the ecological factor does not play a role in forming cloud computing intentions, regardless of prior knowledge or experience. Empirical evidence of this study suggests increasing efforts for informing actual and potential users, particularly in respect to possible ecological advantages through applying the new IT infrastructure.

Keywords: Cloud computing, Theory of reasoned action (TRA), Technology acceptance model (TAM)

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